DRAFT Water Quality Management Plan (WQMP)

for:

Kaiser Permanente

Foothill Ranch Medical Office Building

Towne Center Drive, Lake Forest

Lot 3 & 4 of Tract 14991

Prepared for:

Kaiser Permanente National Facilities Services
P.O. Box 12916 Oakland, CA 94604

Prepared by:

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August 2011

Owner's Certification Water Quality Management Plan (WQMP)

Project Name: Kaiser Permanente Foothill Ranch Medical Office Building
Tract/Parcel Map Number: Lots 3 and 4 of Tract No 14991

This Water Quality Management Plan (WQMP) has been prepared for Kaiser Permanente National Facilities Services. The WQMP is intended to comply with the requirements of the City of Lake Forest Urban Runoff Management Program and Stormwater Ordinance, as well as the Municipal Stormwater Permit which requires the preparation of WQMPs for priority development projects.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this WQMP. The undersigned will ensure that this plan is carried out and amended as appropriate to reflect up-to-date conditions on the site consistent with the current City of Lake Forest Urban Runoff Management Program and the intent of the NPDES/MS4 Permit for Waste Discharge Requirements as authorized by the State and EPA. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Signed: _____

Name: _____

Title: _____

Company: _____

Address: _____

Telephone #: _____

Date: _____

Email Address: _____

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Section 1 Project Description

1.	**Detailed development description:** The project includes the construction of a one-story 21,500 GSF medical office building with approximately 1.7 acres of paved parking lot and driveway. The proposed development is limited to approximately 3.6 acres located on the northeast quadrant of the site.
2.	**Project location and site address:** The project is located on the south side of Towne Center Drive in the City of Lake Forest. It is bordered by Lake Forest Drive on the east side and the on-ramp to route 241 on the south side. The project is located within the North Orange County permit area.
3.	**Property size:** The property is composed of two parcels totaling 255,219 square feet (5.9 acres). A lot line adjustment is proposed to merge the two parcels.
4.	**Existing use:** The site is currently vacant and undeveloped.
5.	**Type of development:** Commercial
6.	**Impervious/pervious surface areas:** Current conditions: Impervious area: 0 acres, Pervious area: 3.6 acres Developed conditions: Impervious area: 2.5 acres, Pervious area: 0.9 acres, or 69% impervious.
7.	**Property ownership:** Private development
8.	**Other:**

Section 2 Project Location Map

The location of the project site is illustrated in Figures 2.1 and 2.2.

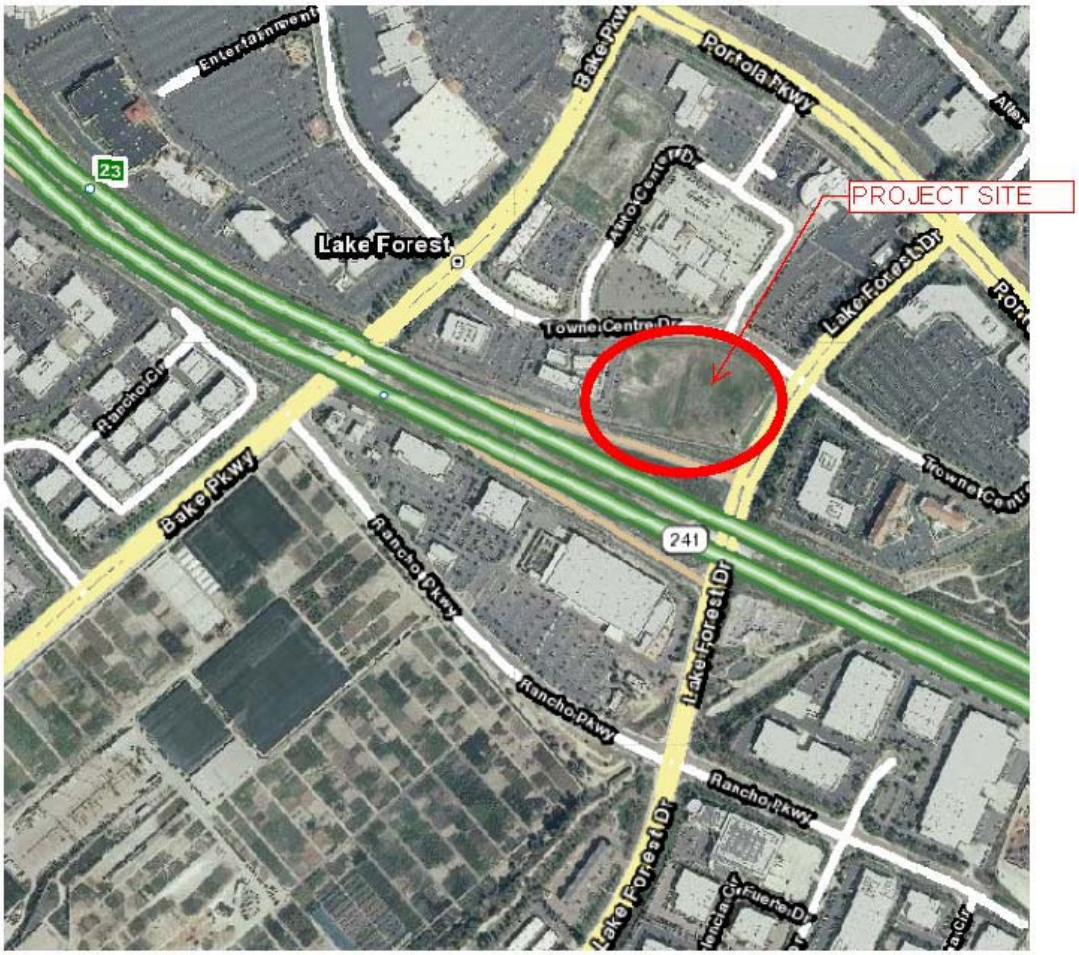


Figure 2.1: Vicinity Map

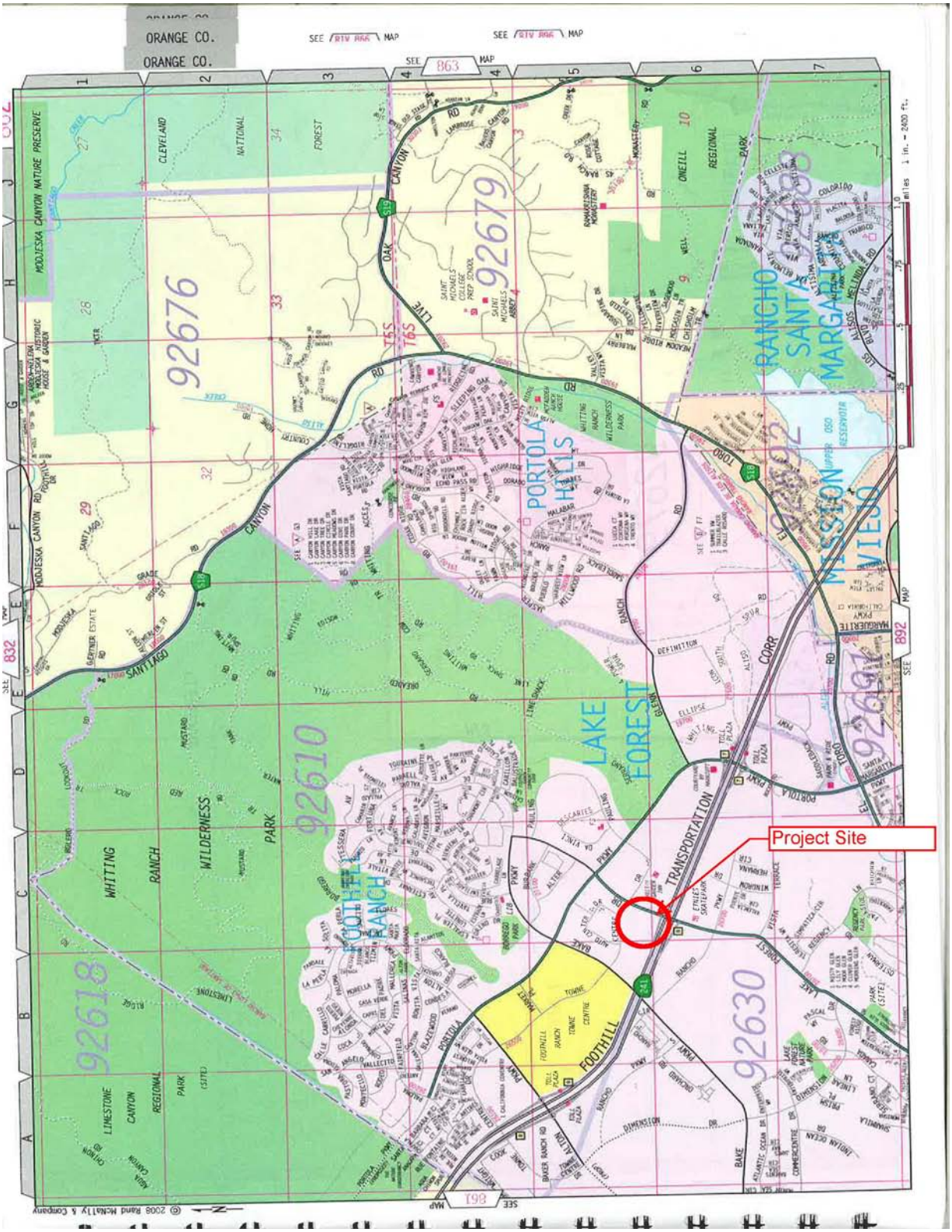


Figure 2.2: Thomas Bros. Map 862

Section 3 Project Site Assessment

This project site assessment section provides important information that is used when considering the potential water quality and hydrologic impacts that could be caused by the proposed project. This information is important when considering the appropriate BMPs to reduce identified potential impacts as well as when developing measures to reduce those impacts.

1.	**Zoning and land use designation:** Zoning: Foothill Ranch Planned Community [PC-8] General Plan Land Use Designation: Commercial
2.	**Existing and proposed drainage:** Existing conditions: The site is currently graded in a south-north direction and slopes towards Towne Center Drive at approximately 2%. An earth berm located along the north frontage of the property prevents storm runoff from flowing directly onto the sidewalk. The site is divided along the existing lot line into two separate drainage areas. The larger lot drains into a temporary desilting basin (sump pit) located at the northeast corner of the site. A perforated standpipe connected to a curb inlet in Towne Center Drive allows the basin to drain into the public storm drainage system. The west lot drains towards the northwest corner of the property. There is no permanent drainage structure to capture the storm runoff before it drains over the sidewalk and into the public street. Proposed conditions: The parking area east of the building and the majority of the phase 1 building roof area will drain to the northeast corner of the site towards a storm water detention/treatment BMP. During large storm events, the runoff in excess of the BMP capacity will overflow to the public storm drain system through the back of the curb inlet located at the corner of Towne Center Drive and Lake Forest Drive. The remainder of the phase 1 improvements will drain towards a second smaller storm water detention/treatment BMP located along the north property line and west of the main entry drive. Phase 2 improvements, mostly located in the west area of the site will be draining towards the northwest corner of the site. Storm water BMPs for future phase 2 improvements will be located along the west border of the site.
3.	**Will the drainage system be modified by the development?** No modification of the drainage system is anticipated.
4.	**Will drainage coincide with City's system or flow to a creek or ocean?** The site will drain to the public storm drain system in Towne Center Drive.
5.	**Watershed and receiving waters:** The project is located in the San Diego Creek Watershed, per the map of Environmentally Sensitive Areas in Section A-1 of the City of Lake Forest Local Implementation Plan. San Diego Creek Watershed is one of Newport Bay's four subwatersheds.
6.	**303(d) Listed Receiving Waters:** According to the list of 303(d) combined list of impaired water bodies dated 2010 and found at http://www.swrcb.ca.gov/water_issues/programs/tmdl/integrated2010.shtml, the project drains to the following impaired receiving waters: • San Diego Creek Reach 1, impaired by Fecal Coliform, Nutrients, Pesticides, Sedimentation/Siltation, Selenium, Toxaphene • San Diego Creek reach 2, impaired by Nutrients, Sedimentation/Siltation, unknown toxicity

- Lower Newport Bay, impaired by Chlordane, Copper, DDT, Indicator bacteria, nutrients, PCBc, Pesticides, Sediment Toxicity
- Upper Newport Bay, impaired by Chlordane, Copper, DDT, Indicator bacteria, Metals, Nutrients, PCBs, Pesticides, Sediment Toxicity, Sedimentation/Siltation

7. Total Maximum Daily Loads (TMDLs): Relevant pollutants Total Maximum Daily Loads (TMDLs) are (per information provided on Orange County Flood Control District website): Newport Bay Sediments TMDL: 62,500 tons per year.

- Newport Bay Watershed total Nitrogen summer load: 153,861 lbs
- Newport Bay Watershed total Nitrogen winter load: 144,364 lbs
- Newport Bay Watershed total phosphorus annual load: 62,080 lbs
- San Diego Creek Reach 2 total nitrogen daily load: 14 lbs
- San Diego Creek and tributaries total chlordane annual load: 255 lbs
- San Diego Creek and tributaries total PCBs annual load: 125 lbs

8. Environmentally Sensitive Areas (ESAs) and/or Areas of Special Biological Significance (ASBS): The project is not located in the Environmentally Sensitive Areas.

9. Soil type(s) and condition: Soils conditions consist of 2 to 45 feet of fill soils, silty sands to clayey sands.

Section 4 Pollutants of Concern

This section of the water quality management plan identifies primary and secondary pollutants of concern. Pollutants of concern are those that are anticipated to be generated by the proposed project. Pollutants of concern are differentiated between primary and secondary depending on the condition of downstream receiving waters. If the project will drain to a receiving water that is impaired for a pollutant anticipated from that project, that pollutant is a primary pollutant of concern. Pollutants frequently identified on the 303(d) list of California impaired water bodies include metals, nitrogen, nutrients, indicator bacteria, pesticides and trash (see 303(d) List). In some cases, there may be specific conditions (i.e. other known water quality problems) that warrant identifying an anticipated pollutant as a primary pollutant of concern. If there is no corresponding impairment or other water quality problem in the receiving waters for an anticipated pollutant, the pollutant is a secondary pollutant of concern.

1.	**Project categories and features:** The priority project category and/or features that correspond to this project are: • Commercial/industrial Development > 100,000 sq.ft • Parking lot According to Table 7.II-2 of Orange County DAMP, Exhibit 7.II, the anticipated pollutants generated by this project are: Heavy metals, organic compounds (including petroleum hydrocarbons), trash & debris, oil & grease Potential pollutants generated by this project are: bacteria/virus, nutrients, pesticides, sediments, oxygen demanding substances
2.	**Primary pollutants of concern:** They consist of the anticipated pollutants for the project identified using DAMP Table 7.II-2 (see list in section1 above) that have also been identified in 303(d) as causing impairment of receiving waters. Heavy metals (copper), nutrients, pesticides (DDT), sediments, organic compounds (toxaphene)
3.	**Secondary pollutants of concern:** Trash and debris, oil and grease.
4.	**Project water quality analyses:** No water quality analysis available
5.	**Project watershed information:** Orange County Public Works website does not indicate any new water quality improvement projects.

Section 5 Hydrologic and Geotechnical Conditions of Concern/Drainage Report

This section of the water quality management plan identifies hydrologic and geotechnical conditions of concern related to the proposed project. Hydrologic or geotechnical conditions of concern are identified through a review of on-site and downstream drainage paths. If the proposed project would cause or contribute flows to problems along on-site or downstream drainage paths, these problems or future problems are considered conditions of concern. Conditions of concern can include problems such as flooding, erosion, scour, and other impacts that can adversely affect channel and habitat integrity.

In order to identify conditions of concern, a comprehensive understanding of flow volume, rate, duration, energy, and peak flow is necessary. Often, a formal drainage study is necessary which considers the project area's location in the larger watershed, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors. As part of the study, the drainage report includes:

- Field reconnaissance to observe downstream conditions
- Computed rainfall and runoff characteristics including a minimum of peak flow rate, flow velocity, runoff volume, time of concentration and retention volume
- Establishment of site design, source control and treatment control measures to be incorporated and maintained to address downstream conditions of concern

A drainage report was not prepared for the proposed project; Possible conditions of concern include downstream channels that are partially unimproved. Their potential to erosion is unknown. The flow rate increase expected from the project additional impervious area would be very small compared to the total flow expected from the channel watershed. However, as a precaution, the project will incorporate storm water detention BMPs designed to minimize flow rate increase compared to pre-development conditions.

A geotechnical report was also prepared for the proposed project by GEOBASE Inc. and dated May 2011, as required by the City. Soils percolation testing was performed by Hushmand and Associates Inc. on May 5, 2011 with a report dated May 11, 2011. Both geotechnical and soils percolation testing reports are included as Appendix A.

1.	**Project location:** The project is located on the east corner of San Diego Creek watershed, bordered by Towne Center Drive, Lake Forest Drive, and the on-ramp to route 241.
2.	**Topography, soil and vegetation:** The site is currently undeveloped and unpaved. The site is relatively flat with elevations ranging from 770 at the northeast corner to 778 at the southwest portion. Soils conditions consist of 2 to 45 feet of fill soils, silty sands to clayey sands. Drainage appears to be good. A sump pit and minor erosion gullies are present at the northeastern corner of the site. The existing slopes adjacent to Lake Forest Drive and the on-ramp leading to the Foothill Transportation Corridor are covered with landscape grasses and small trees. These slopes vary from 6 to 25 feet in height and have an

	approximate slope ratio of 2 Horizontal : 1 Vertical. An erosion gully of up to approximately 10 to 12 feet wide and 3 to 5 feet deep is present on the slope at the junction of Lake Forest Drive and the on-ramp to the Foothill Transportation Corridor. The gully is vegetated with small trees and bushes.
3.	**Impervious area:** Existing % impervious area: 0% Proposed % impervious area: 69%
4.	**Drainage features:** The site is divided along the existing lot line into two separate drainage areas. The larger lot drains into a temporary desilting basin (sump pit) located at the northeast corner of the site. A perforated standpipe is connected to the back of an existing City curb inlet in Towne Center Drive through an 18-inch diameter pipe and allows the desilting basin to drain to the City of Lake Forest storm drain pipe located below the street. The 42-inch diameter City storm drain pipe below Towne Center Drive connects to a 60-inch diameter concrete storm drain owned and operated by the County Flood Control District and located below Lake Forest Drive. The west lot drains towards the northwest corner of the property. There is no permanent drainage structure to capture the storm runoff before it drains over the sidewalk and into the public street.
5.	**Relevant hydrologic and environmental factors:** There are no relevant hydrologic or environmental factors.
6.	**Proposed hydrologic conditions:** Due to increase in impervious area, the runoff volume from the site is expected to increase. Please refer to the Hydrology Report Summary below. Detention / Bio-retention basins will be provided to limit post construction flow to pre-development values.
7.	**Significant impact on downstream channels and habitat integrity:** The proposed development is expected to increase the runoff volume and the peak flow rate. Portions of the downstream drainage system consist of natural channels possibly sensitive to significant increase in flow rate. However with implementation of the proposed stormwater BMPs, the impact to downstream channels and habitat integrity is expected to be less than significant.
8.	**Project hydrology analyses:** There are no previous reports or analyses related to project's potential hydrologic impacts.
9.	**Project watershed information:** In October 2009, Orange County issued a draft Environment Impact Report for their San Diego Creek Flood Control Channel (F05), Upper Newport Bay to Interstate 405, Programmatic Operations and Maintenance Project. According to the EIR, San Diego Creek Channel's flood control capacity decreased from 100 yr storm conveyance (33,400 cfs) to 5 yr storm conveyance (18,000 cfs) due to an accumulation of sediments and vegetation growth. The project proposes to implement standard maintenance procedures and restore Channel's 100 yr flood control capacity.

Hydrology Report Summary

Hydrology report is not available. However, based on a preliminary calculation, the 10 yr storm peak flow is anticipated to increase from 12.5 cfs to 15.9 cfs, and the 25 yr storm peak flow is anticipated to increase from 15.1 cfs to 19.1 cfs.

Existing - 10 yr

	Area	T_c	Intensity	F_m	Q = 0.9 (I-F_m) A
E1	2.51	12.5	2.4	0.2	5.0
E2	2.99	12	2.5	0.2	6.2
E3	0.36	5	4.1	0.2	1.3
				Total	12.5 cfs

Proposed - 10 yr

	Area	T_c	Intensity	F_m	Q = 0.9 (I-F_m) A
P1	1.50	11	2.6	0.2	3.2
P2	3.58	8	3.1	0.06	9.8
P3	0.82	5	4.1	0.2	2.9
				Total	15.9 cfs

Existing - 25 yr

	Area	T_c	Intensity	F_m	Q = 0.9 (I-F_m) A
E1	2.51	12.5	2.9	0.2	6.1
E2	2.99	12	3.0	0.2	7.5
E3	0.36	5	4.95	0.2	1.5
				Total	15.1 cfs

Proposed - 25 yr

	Area	T_c	Intensity	F_m	Q = 0.9 (I-F_m) A
P1	1.50	11	3.1	0.2	3.9
P2	3.58	8	3.7	0.06	11.7
P3	0.82	5	4.95	0.2	3.5
				Total	19.1 cfs

The required detention volume to match pre-development peak flow is 2,700 cu ft and 3,400 cu ft respectively for 10 yr and 25 yr storm event. The proposed bio-retention basins are expected to provide a storage volume greater than the required detention volume.

Section 6 Best Management Practices (BMPs)

Minimizing a development's effects on water quality and the environment can be most effectively achieved by using a combination of BMPs which include Site Design, Source Control and Treatment Control measures. These design and control measures employ a multi-level strategy. The strategy consists of: 1) reducing or eliminating post-project runoff; 2) controlling sources of pollutants; and 3) treating stormwater runoff before discharging it to the stormdrain system or to receiving waters.

This WQMP and the proposed BMPs for the proposed project have been developed to minimize drainage impacts identified in Section 5 and the introduction of pollutants identified in Section 4 into the municipal stormdrain system and/or ultimate drainage receiving water body.

For more detailed information on the use and design of BMPs please see the California Stormwater Quality Association New development and Redevelopment handbook. The handbook is available at www.cabmphandbooks.com. Additional information is also available in the City's LIP.

6.1 Site Design BMPs

The most effective means of avoiding or reducing water quality and hydrologic impacts is through incorporation of measures into the project design. These measures should be taken into consideration early in the planning of a project as they can affect the overall design of a project.

The design of the proposed project has considered and incorporated site design concepts as described below.

SITE DESIGN CONCEPT 1: MINIMIZE STORMWATER RUNOFF, MINIMIZE PROJECT'S IMPERVIOUS FOOTPRINT AND CONSERVE NATURAL AREAS

1.	**Minimizing impervious footprint:** Only necessary building space, parking stalls and drive aisles will be built. Anticipated future growth in building, parking space needs and associated drive aisles will only be constructed during future Phase 2. Phase 2 footprint will remain undeveloped during Phase 1. Parking pavement footprint is minimized by provided double-loaded parking aisles. Paved roadway is also reduced to a maximum extent practicable by proposing unpaved gravel loop road for emergency vehicles.
2.	**Conservation of natural areas:** The project site does not contain natural areas. Existing planted buffer around site will be increased and enhanced per the Foothill Business Association requirements.
3.	**Use of permeable paving or other surfaces:** The site soils percolation rates as tested by Hushmand Associates, Incorporated (0.1 gal/sf/day to 0.4 gal/sf/day or 0.007 to 0.028 in/h per soils percolation testing report dated May 11, 2011) are too low to make storm runoff infiltration a viable storm water management strategy. Permeable pavement surfaces rely on a good subsoil infiltration rate (> 0.5 in/h) to perform effectively. Permeable surfaces and other strategies relying on water percolation through the existing soils won't be used on this project.

4.	**Designing to minimum widths necessary:** All drive aisles are designed to minimum widths with the exception of the primary drive entrance which is slightly wider than required to allow for easier access for member drop-off and the fire department. The main pedestrian sidewalk access is also slightly wider than required to accommodate patient access to the facility, accessible parking and patient drop-off, pick-up and waiting.
5.	**Incorporation of landscaped buffers:** Landscaped buffers will be located along Main north-south walkway path between building entrance and public sidewalk.

6.	**Reduced street widths:** Not applicable. All drive aisles will have parking on both sides.
7.	**Maximize canopy interception:** We are using several types of evergreen and deciduous trees on this project. Broad leafed canopy trees have been utilized in the parking lot and open areas that offer beneficial canopy interception of rainfall. There are also several other types of densely foliated trees that will offer rainfall interception as well. .
8.	**Use of native or drought tolerant trees/shrubs:** There are no existing native trees or shrubs on this project. The new plant material we have introduced is drought tolerant, California friendly Trees, shrubs and groundcovers. A variety of drought tolerant grasses and trees will be utilized in the bio-retentions basins on the project in an effort to conserve water.
9.	**Minimizing impervious surfaces in landscaping:** The landscaping design does not add impervious areas to the project.
10.	**Use of natural drainage systems:** The project is intending to minimize the use of underground storm drain pipes and to promote overland flow across paved and unpaved surfaces, in an attempt to emulate the current drainage conditions and minimize the reduction of the time of concentration and flow duration.
11.	**Low flow infiltration:** Because of very poor soils percolation characteristics (see item #3 above), no storm water runoff infiltration will be implemented for this project.
12.	**Onsite ponding areas or retention facilities:** The project primary storm water management strategy consists of collecting the surface runoff in two large bio-retention basins covering approximately 20,000 square feet. The storm water will be allowed to pond in the basins before being filtered through engineered layers of soils and gravel. A system of perforated subdrains will collect the filtered water at the bottom of the bio-retention basins and drain out to the public storm drain system in Towne Center Drive.
13.	**Other site design features:**

SITE DESIGN CONCEPT 2: MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREAS (DCIAs)

1.	**Draining rooftops into adjacent landscaping:** Per the design and planning guidelines of the Foothill Business Association the roof downspouts will not drain directly into landscaped areas. The rooftop runoff will sheet flow across the project parking area, then flow into landscaped bio-retention basins where the water will pond and be filtered before flowing into a pipe and out the public storm drainage system.
2.	**Draining to adjacent landscaping:** All site impervious areas (roof, sidewalk and parking pavement) will be drained to landscaped bio-retention basins where the water will pond and be filtered before flowing into a pipe and out the public storm drainage system
3.	**Vegetated drainage swales:** Bio-swales or vegetated drainage swales are not proposed. However the project is intending to minimize the use of underground storm drain pipes and to promote overland flow across paved and unpaved surfaces, in an attempt to emulate the current drainage conditions and minimize the reduction of the time of concentration and flow duration.
4.	**Site drainage system:** In this project bio-retention basins are being implemented in lieu of swales and provide the same benefits of detention and treatment capabilities. Conveyance of the runoff will be mostly done through sheet flow across the parking and landscaped areas.
5.	**Residential driveways:** No residential driveway in this project.
6.	**Residential parking areas:** No residential parking areas in this project.
7.	**Non-residential parking areas:** The runoff from the parking area will flow to the landscaped bio-retention basins before draining to the public storm drainage system in the street. No overflow parking is anticipated in this phase of the project.

6.2 Source Control BMPs

Source Control BMPs are measures focusing on reducing or eliminating post-project runoff and controlling sources of pollutants. Source Control BMPs must be included in all projects and can be represented in structural measures such as landscape, irrigation, signage considerations, materials, and design of areas; and non-structure measures such as requirements, cleaning, education, and maintenance.

Table 6.1 Source Control Non-Structural BMPs

Number	BMP and Objective	Included
Routine Non-Structural BMPs (numbers correspond to those in City's WQMP)		
N1	**Education for Property Owners, Tenants and Occupants:** Practical informational materials are provided to residents, occupants, or tenants to increase the public's understanding of stormwater quality, sources of pollutants, and what they can do to reduce pollutants in stormwater. *Explanation/Description:* Education to occupants on issues related to storm water pollution prevention will be performed according to Kaiser Permanente standards.	Y
N2	**Activity Restrictions:** Rules or guidelines for developments are established within appropriate documents (i.e. CC&Rs, lease terms, etc.) which prohibit activities that can result in discharges of pollutants. *Explanation/Description:*	Y
N3	**Common Area Landscape Management:** Specific practices are followed and ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water, and reduce pesticide and fertilizer applications. *Explanation/Description:* Plant species have been selected to minimize use of fertilizers and pesticides. Drought tolerant, California friendly trees, shrubs and groundcovers will be utilized on the project in an effort to conserve water.	Y
N4	**BMP Maintenance:** In order to ensure adequate and comprehensive BMP implementation, all responsible parties are identified for implementing all non-structural BMPs and for structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities. *Explanation/Description:* All structural BMPs will be maintained per Section 8 of this report.	Y
N5	**Title 22 CCR Compliance:** Hazardous waste is managed properly through compliance with applicable Title 22 regulations. *Explanation/Description:* Hazardous waste is managed according to Kaiser Permanente safety standards and Hazard Communication Program	Y
N6	**Local Water Quality Permit Compliance:** The project complies with water quality permits issued by the City to ensure clean stormwater discharges. *Explanation/Description:* Project storm water design has been developed to comply with City of Lake Forest storm water regulations	Y

N7	**Spill Contingency Plan:** A Spill Contingency Plan is implemented to ensure that spills are managed properly by requiring stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc. *Explanation/Description:* Spill responses follow Kaiser Permanente standards	Y
N8	**Underground Storage Tank Compliance:** Because of the known or potential presence of underground storage tanks (USTs) on the project site, applicable UST regulations apply and are adhered to in order to avoid harm to humans or the environment. *Explanation/Description:* There is no known existing underground storage tank on this site	N
N9	**Hazardous Materials Disclosure Compliance:** Because hazardous materials or wastes will be generated, handled, transported, or disposed of in association with the project, measures are taken to comply with applicable local, state, and federal regulation to avoid harm to humans and the environment. *Explanation/Description:* Hazardous waste management will be in compliance with regulations.	Y
N10	**Uniform Fire Code Implementation:** The project includes a hazardous material storage facility or other area regulated by Article 80 and therefore implements measures to comply with this section of the Uniform Fire Code. *Explanation/Description:*	Y
N11	**Common Area Litter Control:** Trash management and litter control procedures are specified, including responsible parties, and implemented to reduce pollution of drainage water. *Explanation/Description:* Regular trash pickup and common area sweeping will reduce pollution of storm water.	Y
N12	**Employee Training:** Practical informational materials and/or training are provided to employees to increase their understanding of stormwater quality, sources of pollutants, and their responsibility for reducing pollutants in stormwater. *Explanation/Description:* Employee training will be performed according to Kaiser Permanente standards.	Y
N13	**Housekeeping of Loading Docks:** Cleaning and clean up procedures are specified and implemented for loading dock areas to keep the area free for pollutants and reduce associated pollutant discharges. *Explanation/Description:* Loading docks are not proposed.	N
N14	**Drainage Facility Inspection:** Inspection procedures, schedules, and responsibilities are established for drainage facilities to ensure regular cleaning, inspection, and maintenance. *Explanation/Description:* Private drainage facilities will be inspected, cleaned, and maintained on an annual basis. Cleaning will take place in the late summer/early fall prior to the rainy season.	Y
N15	**Street Sweeping Private Streets and Parking Lots:** Street sweeping frequency and responsible parties are identified and regular sweeping is conducted to reduce pollution of drainage water. *Explanation/Description:* Streets and parking lots will be swept prior to the storm season, in late summer or early fall.	Y

N17	**Retail Gasoline Outlets:** Specific operational and maintenance BMPs are implemented to the extent feasible to reduce potential for pollutant discharge from wash off by runoff, leaks, and spills. *Explanation/Description:* Fueling areas are not proposed.	N

Number	BMP and Objective	Included
Source Control Structural BMPs (numbers correspond to the California BMP Handbook)		
SC-10	**Site Design and Landscape Planning:** Landscape planning methodologies are incorporated into project design to maximize water storage and infiltration opportunities and minimize surface and groundwater contamination from stormwater. *Explanation/Description:* The storm runoff is diverted to landscaped basins where the water is detained and filtrated. However, due to the poor infiltration quality of the soils and the thickness of the fill layer the project is built on; the site has been designed to minimize storm water infiltration into the subsoils.	Y
SC-11	**Roof Runoff Controls:** Direct roof runoff away from paved areas and to pervious areas, cisterns, infiltration trenches, and/or storage areas for reuse to reduce total volume and rate of site runoff and retain pollutant on site. *Explanation/Description:* Per the design and planning guidelines of the Foothill Business Association the roof downspouts will not drain directly into landscaped areas. However, the rooftop runoff will sheet flow across the project parking area, then flow into landscaped bio-retention basins where the water will pond and be filtered before flowing into a pipe and out the public storm drainage system.	Y
SC-12	**Efficient Irrigation:** Project plans include application methods to minimize irrigation water discharged into stormwater drainage systems. *Explanation/Description:* Irrigation is designed to severely limit overthrowing of irrigation water on pavement, walks, walls and common areas, as per the design and planning guidelines of the Foothill Business Association	Y
SC-13	**Stormdrain System Signs:** Stencils or affixed signs a placed adjacent to stormdrain inlets to prevent waste dumping at stormdrain inlets. *Explanation/Description:* All storm drain inlets and catch basins within the project area will be stenciled with prohibitive language and/or graphical icons to discourage illegal dumping. Legibility of stencils and signs will be maintained.	Y
SC-20	**Pervious Pavements:** Porous concrete or asphalt, blocks with pervious spaces or joints, or grass or gravel surfaces are employed to reduce runoff volume and provides treatment. *Explanation/Description:* Pervious pavements are not proposed.	N
SC-21	**Alternative Building Materials:** Specialized building materials are employed that have lower potential to leach pollutants, and reduce need for future painting or other pollutant generating maintenance activities. For example, some treated wood contains pollutants that can leach our to the environment and some metal roofs and roofing materials result in high metal content in runoff.	N

	Explanation/Description: Specialized building materials are not proposed due to the cost.	
SC-30	**Fueling Areas:** Project plans are developed for cleaning, spill cleanup, containment, leak prevention, and incorporation of design to reduce rain and runoff that could come in contact with fueling areas. *Explanation/Description:* Fueling areas are not proposed.	N
SC-31	**Maintenance Bays and Docks:** Project design incorporates measures to cover or otherwise eliminate run-on and off from bays and docks, and direct connections to stormdrain are eliminated. *Explanation/Description:* Loading docks are not proposed.	N
SC-32	**Trash Enclosures:** Trash storage areas are covered and enclosed to prevent introduction of trash and debris to site runoff. *Explanation/Description:* Trash enclosure area will be covered. Any trash container areas will have drainage from adjoining roofs and pavement diverted around the area(s). In addition, they will be screened or walled to prevent off-site transport of trash.	Y
SC-33	**Vehicle and Equipment Washing Areas:** Designated wash areas or facilities are contained and wash water is reused, treated, or otherwise properly disposed of. *Explanation/Description:* Vehicle and Equipment Washing Areas are not proposed	N
SC-34	**Outdoor Material Storage Areas:** Outdoor storage areas for materials containing pollutants, especially hazardous materials, are covered and enclosed, on impervious surfaces, and include secondary containment when applicable. *Explanation/Description:* Outdoor material storage areas are not proposed	N
SC-35	**Outdoor Work Areas:** Outdoor work areas are covered, contained, and treated as necessary to reduce opportunity of pollutants from work activities to enter stormwater. *Explanation/Description:* Outdoor work areas are not proposed	N
SC-36	**Outdoor Processing Areas:** Outdoor processing areas are covered, contained, and treated as necessary to reduce opportunity of pollutants from work activities to enter stormwater. *Explanation/Description:* Outdoor processing areas are not proposed.	N

6.3 Treatment Control BMPs

Treatment control BMPs utilize treatment mechanisms to remove pollutants that have entered stormwater runoff and consist of public domain BMPs (identified in the following table with as TC-##) and manufactured or proprietary BMPs (identified in the following table with as MP-##). BMP numbers correspond to the California BMP Handbook.

The following table identifies the treatment control BMPs included in the proposed project.

Table 6.2 Treatment Control BMPs

Number	BMP and Objective	Included
	Infiltration	
TC-10	**Infiltration Trench:** A long narrow rock filled trench with no outlet receives water and stores it until it infiltrates into the underlying soil. Its effective are removing most pollutants but can get clogged with sediment. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-11	**Infiltration Basin:** A shallow impoundment designed to capture and hold stormwater until it infiltrates into underlying soil. Effective at removing most pollutants but requires large areas and may be constrained by soil types. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-12	**Retention/Irrigation:** Stormwater is captured in cistern, basin, trench, or other storage area and is subsequently used for irrigation of site landscaping. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
	Detention and Settling	
TC-20	**Wet Pond:** A constructed basin with a permanent pool of water throughout the year. Differ from wetlands because it is of greater depth. Treats stormwater runoff by settling and biological uptake. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-21	**Constructed Wetland:** A constructed basin with permanent pool of shallow water throughout most of year with substantial vegetative coverage. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-22	**Extended Detention Basin:** A constructed basin with an outlet designed to detain stormwater for at least 48 hours to allow particles and pollutants to settle. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
MP-20	**Wetland:** Similar to a constructed wetland but a self contained, manufactured module with vegetation that mimics natural wetland processes. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
	Biofiltration	

TC-30	**Vegetated Swale:** Open, shallow, vegetated channels that collect and slowly convey runoff through the property. Filters runoff through vegetation, subsoil matrix, and/or underlying soils; traps pollutants, promotes infiltration and reduce flow velocity. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-31	**Vegetated Buffer Strip:** Vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Removes pollutants by deceleration, settling, and infiltration. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
TC-32	**Bioretention:** A soil and plant based filtration strategy that involved capturing stormwater in depressed landscaped areas. Bioretention practices are flexible strategies for using landscaping as treatment. *Explanation/Description:* Bioretention is proposed on the north and the north-east corner of the property.	Y
	Filtration	
TC-40	**Media Filter:** Usually two-chambered with a pretreatment settling basin and a filter bed filled with sand or other absorptive filter media. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
MP-40	Media Filter: Similar to constructed media filter but manufactured as self-contained filtering vaults, units, or cartridges. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
	Flow Through Separation	
TC-50	**Water Quality Inlet:** Vaults with chambers including screens, settling areas, and/or filter media to promote settling and/or separation of pollutants from stormwater. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
MP-50	**Wet Vault:** A vault with a permanent water pool and internal features to promote settling and/or separation of pollutants from stormwater. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
MP-51	**Vortex Separator:** Similar to wet vaults but round and use centrifugal action as primary separation mechanism. *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
MP-52	**Drain Inserts:** Boxes, trays, or socks with screens or filter fabric and may also include filter media. They are installed in inlets or catch basins and removal effectiveness for pollutants is generally low except for large sediment. *Note: Drain inserts cannot be the sole Treatment Control BMP selection for Priority Projects.* *Explanation/Description:* Implementing Bioretention as the treatment BMP.	N
	Other	
TC-60	**Multiple Systems:** A system that uses two or more BMPs in series to increase treatment. Useful when one BMP does not provide sufficient treatment alone.	N

Explanation/Description: Implementing Bioretention as the treatment BMP.

6.3.1 SELECTION

As stated in Section 4, the primary pollutants of concern associated with this project includes metals (copper), nutrients, pesticides, sediments. Runoff from the proposed surface parking lot is anticipated to contain heavy metals, organic compounds (including petroleum hydrocarbons), trash & debris, oil & grease.

As Table 7-II-6 of Orange County DAMP states, Bio-retention has high to medium efficiency on sediment and oil & grease, therefore is appropriate as a treatment BMP for this project.

6.3.2 SIZING

Per Section 7 of the City's LIP and Exhibit 7.II of the DAMP, the Stormwater Quality Design Volume (SQDV) and the Stormwater Quality Design Flow (SQDF) are calculated to be 8,442 cu. ft. and 0.49 cfs, respectively.

SQDF

$Q_{P,SQDF}$ = C x I x A = 0.68 x 0.2 x 3.6 = 0.49 cfs
C: Based on Table A-1 for 69% impervious
A: Area of development only (3.6 acres)

.

SQDV

V_b = C x I x A_t = 0.68 x (0.95 x 1/12) x (3.6 x 43560) = 8,442 cu ft.

BMP Sizing Calculations

A = (V_{design} x 2) / [t x (P_{design}/12) x (d+l)] = (8442 x 2) / [48 x 0.375/12 x (1+2)] = 3,752 sqft
Pdesign: design percolation rate [assumed to be 0.375 in/hr with an underdrain]
d: ponding depth (ft)
l: depth of planting media (ft)
t: required drawdown time (hr) [48hrs]

Based on the preliminary site plan, the total area of the proposed bio-retention is approximately 13,800 sqft.

6.3.3 LOCATION

The site is graded to drain from south to north. Phase 1 bio-retention basins are proposed on the north and north-east corner of the property. Runoffs from the proposed

parking lot will sheet-flow to the proposed BMPs. Please refer to the attached BMP exhibit.

6.3.4 RESTRICTIONS ON USE OF INFILTRATION BMPS

The proposed project does not include infiltration BMPs.

Section 7 Project Plan and BMP Location Map

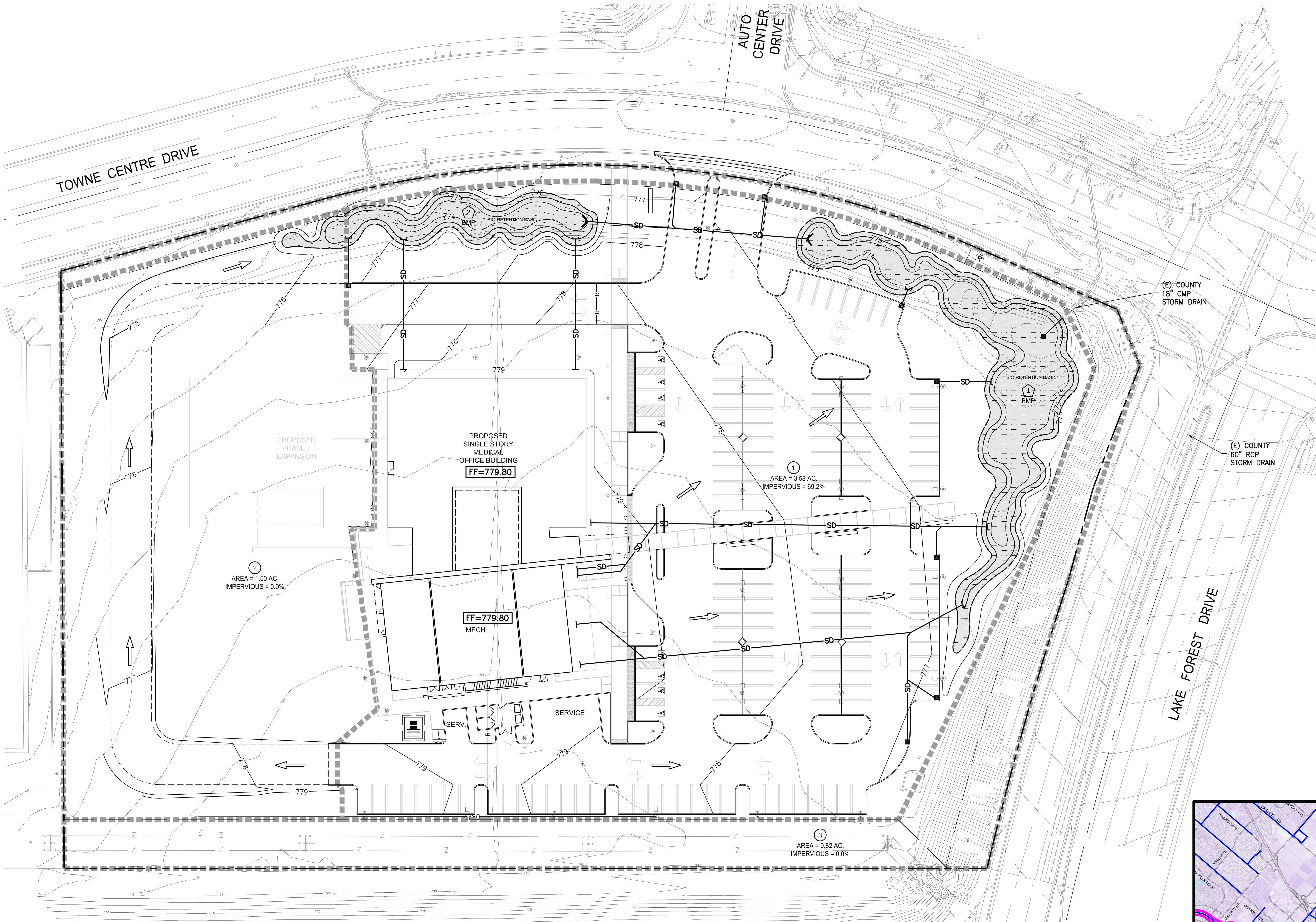
Figure 7.1 illustrates the proposed project and the Source Control structural and Treatment BMPs that will be implemented pursuant to this WQMP. The following checklist identifies the required information that is included in the BMP map.

Included	Requirement
X	Legend, north arrow, scale
X	Show drainage arrows, and drainage areas
X	Entire property on one map (provided sufficient detail is shown)
X	Show structures to be constructed and removed
X	Show proposed and existing stormdrain systems
X	Show all external hardscape surfaces such as walkways, driveways, pools, spas, patio areas etc.
X	Indicate the landscape areas and planters
X	Show nearby waterbodies by name, if available
X	Identify site outlet and/or connection to municipal stormdrain system
X	Identify locations of all source control structural and treatment BMPs on the Map. Indicate the BMP location using the BMP number.
X	Differentiate/identify pervious and impervious surfaces, buildings, activity areas, etc.
X	Identify areas of potential soil erosion

[add BMP map here]

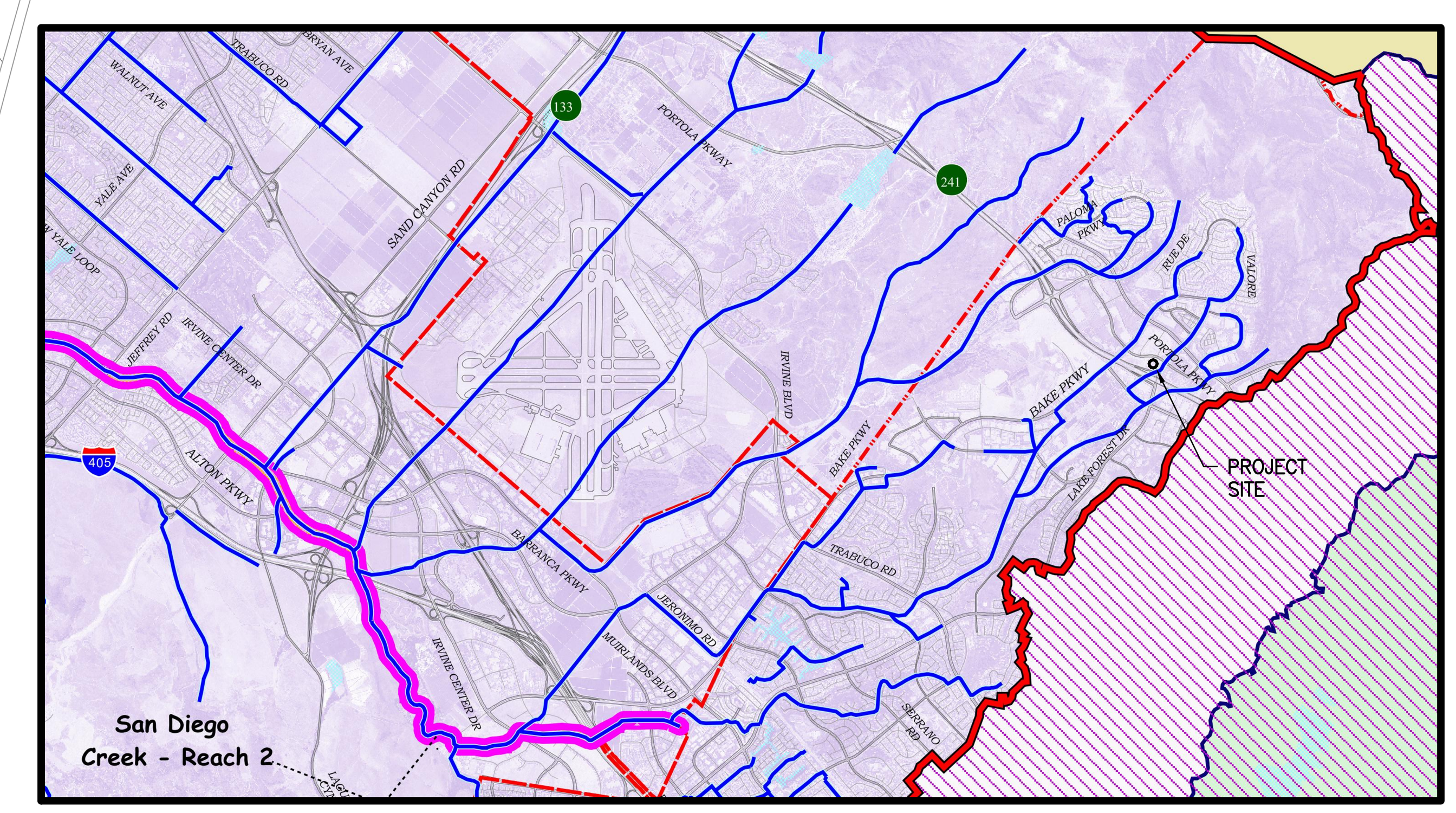
GRAPHIC SCALES: 1/16" = 1'-0" | 1/8" = 1'-0" | 1/4" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1-1/2" = 1'-0" | 3" = 1'-0"

IF THIS SHEET IS NOT 30"x42", IT IS A REDUCED PRINT - SCALE ACCORDINGLY

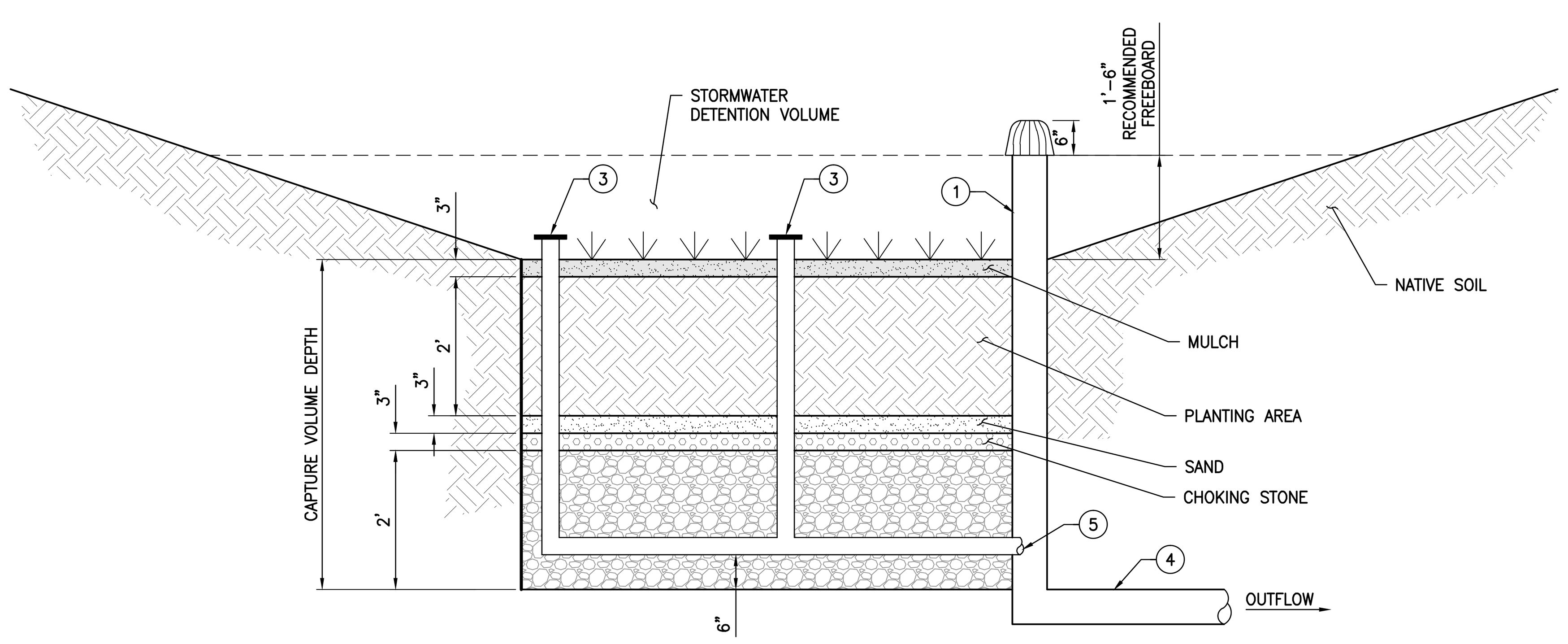


LEGEND:

- DRAINAGE AREA
- PROPERTY LINE
- PROPOSED BIO-RETENTION
- (1) 10,200 SQ. FT.
- (2) 3,600 SQ. FT.



SAN DIEGO CREEK WATERSHED



1 BIO RETENTION/DETENTION BASIN TYPICAL SECTION
HEREON N.T.S.

NOTES:

1. OVERFLOW DEVICE WITH WEIR LENGTH SIZED TO CONVEY THE DESIGN DISCHARGE AS REQUIRED BY THE ORANGE COUNTY LOCAL DRAINAGE MANUAL AND HYDROLOGY MANUAL OR THE LOCAL PERMITTING AUTHORITY
2. SLOTTED 6" MIN. PVC PIPE UNDERDRAIN (C/D SOILS ONLY)
3. 6" MIN PVC PIPE CLEANOUT (C/D SOILS ONLY)
4. OUTLET PIPE SIZED TO CONVEY THE DESIGN DISCHARGE AS REQUIRED BY THE ORANGE COUNTY LOCAL DRAINAGE MANUAL AND HYDROLOGY MANUAL OR THE LOCAL PERMITTING AUTHORITY
5. BLIND FLANGE AT END OF SLOTTED UNDERDRAIN DRILLED TO SPECIFIC ORIFICE DIAMETER (C/D SOILS ONLY)

PLAN
SCALE: 1" = 30'-0"
GRAPHIC SCALE

KAISER PERMANENTE®

National Facilities Services
Post Office Box 12916
Oakland, California 94604

Revisions

No.	Revisions	By	Date	Appr.
-	NFS Gate 3 Submittal		4/15/11	
-	100% Design Development / NFS Gate 4 Submittal		7/29/11	
-	Site Development Permit Re-submittal		8/22/11	

FRANK R. WEBB architects

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6080 Center Dr. Suite 700
Los Angeles, California 90045
(310) 665-2800 Fax (310) 665-9075

REGISTERED PROFESSIONAL ENGINEER No. C59894 Exp. 12/31/11 CIVIL STATE OF CALIFORNIA — NOT FOR CONSTRUCTION

Project Architect Approval:

Architect/Engineer Of Record:

Facility
FOOTHILL RANCH MOB
26882 TOWNE CENTRE DRIVE
LAKE FOREST, CA 92610

Project
FOOTHILL RANCH MEDICAL OFFICE BUILDING

Sheet Title
WATER QUALITY MANAGEMENT PLAN PHASE 1

Building ID:	Floor Lev: 01	Section:
Scale	PER PLAN	KP Proj. No. H0063
Drwn By	TN	Permit No. ** ******-**
Chckd By	CB	Sheet EXHB-A
Issue Date	5/10/2011	Of 10 Sheets

Section 8 Stormwater BMP Maintenance

The City does not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an Operations and Maintenance (O&M) Plan is prepared and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs.

The Kaiser Permanente Foothill Range Medical Office Building project will implement the following maintenance mechanism to ensure ongoing long-term maintenance of all structural and non-structural BMPs.

8.1 Operation and Maintenance (O&M) Plan

An O&M Plan will be prepared for the proposed project and must be approved by the City prior to construction approvals, permit close out and issuance of certificates of use and occupancy. The O&M Plan describes the designated responsible party to manage the stormwater BMP(s), employee's training program and duties, operating schedule, inspection and maintenance frequencies, routine service schedule, specific maintenance activities, copies of resource agency permits, and any other necessary activities. At a minimum, maintenance agreements shall require the inspection and servicing of all structural BMPs per manufacturer or engineering specifications. Parties responsible for the O&M plan shall retain records for at least 5 years. These documents shall be made available to the City for inspection upon request at any time.

Desig-nator. Code (e.g. N1 or SC-1)	BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
N14	*Drainage Facility Inspection*	Private drainage facilities will be inspected, cleaned, and maintained on an annual basis. Cleaning will take place in the late summer/early fall prior to the rainy season.	
N15	*Street Sweeping Parking Lots*	Streets and parking lots will be swept prior to the storm season, in late summer or early fall.	
Structural Source Control BMPs			
SC-13	*Stormdrain System Signs*	Stencil shall be inspected a minimum of one year and reapplied if necessary	

Treatment Control BMPs			
TC-32	*Bioretention*	Bioretention areas require annual plant, soil, and mulch layer maintenance to ensure optimum pollutant removal capability.	

Required Posting

A statement requiring the above table to be laminated and posted in the primary maintenance worker assembly area(s) related to the project shall be included in the WQMP.

Required Permits

List any permits required for the implementation, operation, and maintenance of the BMPs. Possible examples are:

- Permits for connection to sanitary sewer
- Permits from California Department of Fish and Game
- Encroachment permits

If no permits are required, a statement to that effect should be made.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

WQMP Operations and Maintenance Log				
Designator Code	Date of Inspection	Date of Maintenance	Verified/ Inspected by	Comments

Appendix A

- Geotechnical Study
- Soils Percolation Testing

HUSHMAND ASSOCIATES, INCORPORATED
Geotechnical, Earthquake and Environmental Engineers

May 11, 2011
GOB-11-003

Mr. John Chevallier, Project Manager
GEOBASE, INC.
23362 Peralta Drive, Unit 6
Laguna Hills, California 92653

RE: PERCOLATION TEST
KAISER PERMANENTE SITE
LAKE FOREST DRIVE
FOOTHILL RANCH, CALIFORNIA

Dear Mr. Chevallier,

Hushmand Associates, Inc. (HAI) is pleased to submit this percolation test and sieve analysis results for Kaiser Permanente project site located at Lake Forest Drive, Foothill Ranch, California. The report includes percolation rate recommendations for the proposed site.

Please refer to the text of the report for detailed recommendations. If there are any questions concerning the findings in the report, please contact HAI.

Very truly yours,

HUSHMAND ASSOCIATES, INC.

Ben Hushmand
for

Naresh Bellana, M.S.
Staff Engineer

Ben Hushmand

Ben Hushmand, Ph.D., P.E. 44777
President, Principal Engineer

250 Goddard Irvine, California 92618 (949) 777-1266 Fax (949) 777-1276
www.hushmand-associates.com

PERCOLATION TESTS AND ANALYSES
KAISER PERMANENTE HOSPITAL SITE
LAKE FOREST DRIVE,
FOOTHILL RANCH, CALIFORNIA

Hushmand Associates, Inc. (HAI) is pleased to submit this Percolation Test report to Geobase Inc. for conducting percolation tests at the proposed Kaiser Permanente Hospital site located at Lake Forest Drive, Foothill Ranch, Orange County, California. The evaluation of percolation rates was performed in accordance with the County of Orange Resources & Development Management Department (County) guidelines.

Drilling for the percolation testing was performed on May 5, 2011. The three percolation test locations (B-1, B-2 and B-3) are presented in Figure 1. Borings were drilled using truck-mounted hollow-stem auger (HSA) drill rig by JDK Drilling. The borings were approximately 7 inches in diameter to a depth of 7 feet below the existing ground surface.

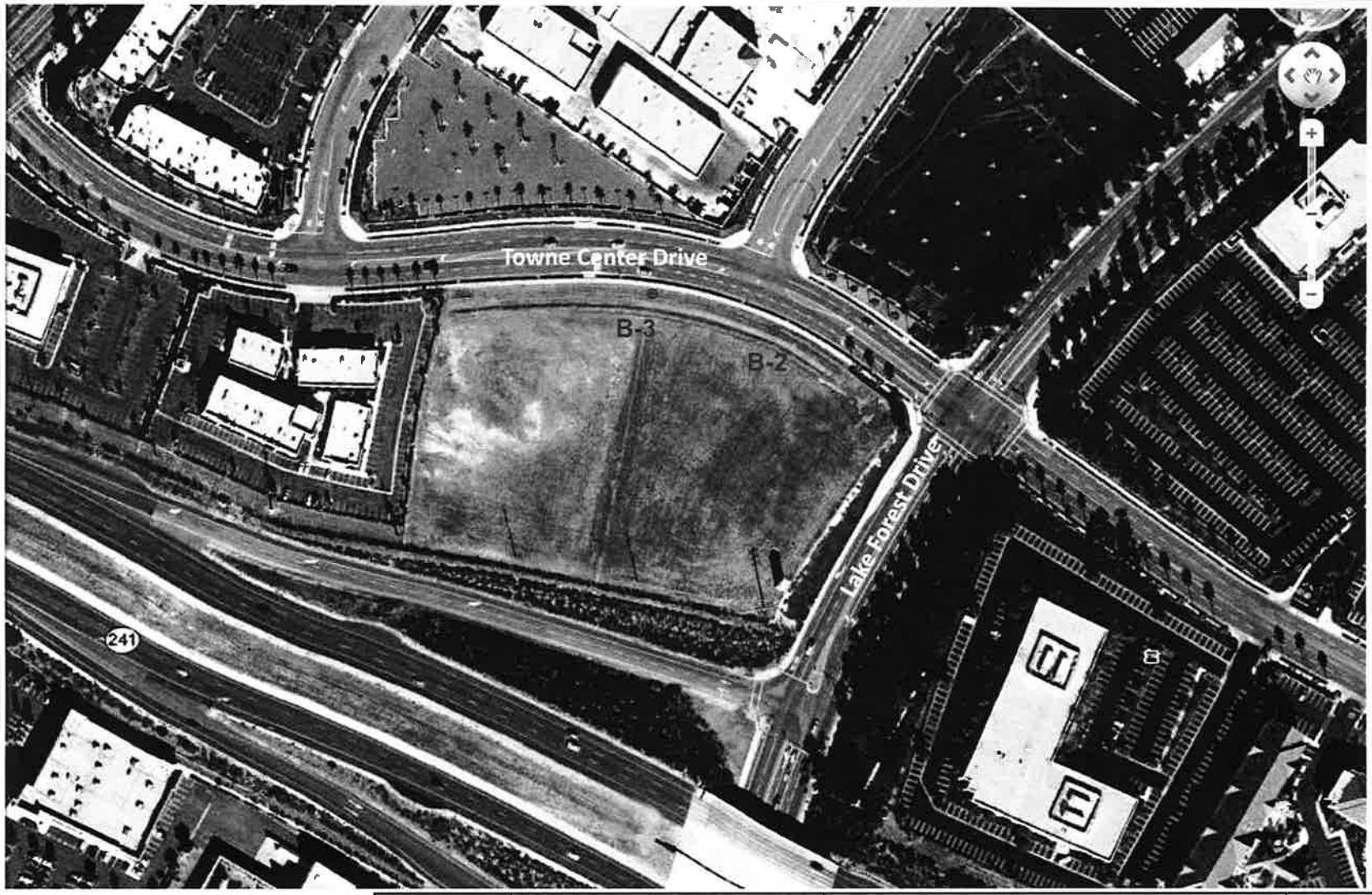
The project site consisted of graded & compacted fill. Boring B-1 consisted of gray, moist Clayey Sand (SC) from the ground surface to 7 feet below ground surface (bgs). Boring B-2 consisted of gray, moist Clayey Sand (SC) from the ground surface to 7 feet bgs and Boring B-3 consisted of gray, moist Clayey Sand (SC) from the ground surface to 7 feet bgs. Groundwater was not encountered in any of the boreholes during drilling.

A perforated 6-inch OD PVC pipe was installed in each of the open holes and the gap between the perforated pipe and the boring wall was filled with gravel to prevent caving during saturation and testing. The hole was presoaked and let set over night. On the next day, the borehole was presoaked again, and after presoaking percolation rates were measured in general conformance with the County guidelines.

Appendix A provides the percolation test readings, calculation tables presented in accordance with the County requirements, and the laboratory sieve analysis test results. Based on the in-situ measurements, the minimum recorded percolation rate of 0.1 gallon per square foot per day (3.8×10^{-6} cm/s) may be used for design at Boring B-1 location. The minimum recorded percolation rate of 0.2 gallon per square foot per day (1.0×10^{-5} cm/s) may be used for design at Boring B-2 location. The minimum recorded percolation rate of 0.4 gallon per square foot per day (1.9×10^{-5} cm/s) may be used for design at Boring B-3 location.

In theory the percolation rate is correlated to the hydraulic conductivity of soil. However, the percolation test is performed in the field condition, which will be affected by parameters such as soil's horizontal and vertical permeability, soil suction, soil saturation, in situ porosity of a larger area of the soil. Therefore, variation of these parameters in short distances should be expected.

Correlations are also available to obtain permeability of fine grained soils using clay fraction (CF), plasticity index (PI), and void ratio (e). A figure is provided in appendix A showing these correlations.



Project No. GOB-11-003	**Kaiser Permanente Hospital** Foothill Ranch, California	**PERCOLATION TEST LOCATIONS**	Figure 1
HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers			

APPENDIX A

PERCOLATION TEST

Project:	Geobase - Lake Forest	**Project #:**	GOB-11-003
Staff:	NB	**Drillers:**	JDK Drilling
Boring Dia. (in):	7.00	**Date Tested:**	May 6, 2011
		Method Used to Prevent Sidewall	
Hours Presaturated:	24.00	**Caving:**	Gravel Packed

Boring ID	Initial Water Depth (ft)	Measured Water Depth (ft)	Start Time (hr:min:sec)	End Time (hr:min:sec)	T, Time Interval (hr)	F, Drop During Time Interval (ft)	L, Average Wetted Depth (ft)	D, Boring Diameter (ft)	Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (in/hr)
B-1	0.00	0.42	11:27:00 AM	11:57:00 AM	0.5000	0.42	6.79	0.58	0.6	0.6	**0.04**
Total Depth (ft):	0.00	0.38	11:58:00 AM	12:28:00 PM	0.5000	0.38	6.81	0.58	0.6	0.5	**0.04**
7	0.00	0.38	12:29:00 PM	12:59:00 PM	0.5000	0.38	6.81	0.58	0.6	0.5	**0.04**
	0.00	0.35	1:00:00 PM	1:30:00 PM	0.5000	0.35	6.82	0.58	0.5	0.5	**0.03**
	0.00	0.33	1:31:00 PM	2:01:00 PM	0.5000	0.33	6.83	0.58	0.5	0.5	**0.03**
	0.00	0.29	2:02:00 PM	2:32:00 PM	0.5000	0.29	6.85	0.58	0.4	0.4	**0.03**
	0.00	0.31	2:33:00 PM	3:03:00 PM	0.5000	0.31	6.84	0.58	0.5	0.5	**0.03**
	0.00	0.29	3:04:00 PM	3:34:00 PM	0.5000	0.29	6.85	0.58	0.4	0.4	**0.03**
	0.00	0.33	3:35:00 PM	4:05:00 PM	0.5000	0.33	6.83	0.58	0.5	0.5	**0.03**
	0.00	0.21	4:06:00 PM	4:36:00 PM	0.5000	0.21	6.90	0.58	0.3	0.3	**0.02**
	0.21	0.35	4:36:00 PM	5:06:00 PM	0.5000	0.15	6.72	0.58	0.2	0.2	**0.01**
	0.35	0.30	5:06:00 PM	5:36:00 PM	0.5000	0.05	6.67	0.58	0.1	0.1	**0.01**

PERCOLATION TEST

Project: Geobase - Lake Forest
Staff: NB
Boring Dia. (in): 7.00

Hours Presaturated: 24.00

Project #: GOB-11-003
Drillers: JDK Drilling
Date Tested: May 6, 2011
Method Used to Prevent Sidewall Caving: Gravel Packed

Boring ID	Initial Water Depth (ft)	Measured Water Depth (ft)	Start Time (hr:min:sec)	End Time (hr:min:sec)	T, Time Interval (hr)	F, Drop During Time Interval (ft)	L, Average Wetted Depth (ft)	D, Boring Diameter (ft)	Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (in/hr)
B-2	0.00	0.29	11:33:00 AM	12:03:00 PM	0.5000	0.29	6.85	0.58	0.4	0.4	**0.03**
Total Depth (ft):	0.00	0.27	12:04:00 PM	12:34:00 PM	0.5000	0.27	6.86	0.58	0.4	0.4	**0.03**
7	0.00	0.25	12:35:00 PM	1:05:00 PM	0.5000	0.25	6.88	0.58	0.4	0.4	**0.02**
	0.00	0.25	1:06:00 PM	1:36:00 PM	0.5000	0.25	6.88	0.58	0.4	0.4	**0.02**
	0.00	0.25	1:37:00 PM	2:07:00 PM	0.5000	0.25	6.88	0.58	0.4	0.4	**0.02**
	0.00	0.25	2:08:00 PM	2:38:00 PM	0.5000	0.25	6.88	0.58	0.4	0.4	**0.02**
	0.00	0.23	2:39:00 PM	3:09:00 PM	0.5000	0.23	6.89	0.58	0.3	0.3	**0.02**
	0.00	0.21	3:10:00 PM	3:40:00 PM	0.5000	0.21	6.90	0.58	0.3	0.3	**0.02**
	0.00	0.21	3:41:00 PM	4:11:00 PM	0.5000	0.21	6.90	0.58	0.3	0.3	**0.02**
	0.00	0.23	4:12:00 PM	4:42:00 PM	0.5000	0.23	6.89	0.58	0.3	0.3	**0.02**
	0.23	0.38	4:42:00 PM	5:12:00 PM	0.5000	0.15	6.70	0.58	0.2	0.2	**0.01**
	0.38	0.52	5:12:00 PM	5:42:00 PM	0.5000	0.15	6.55	0.58	0.2	0.2	**0.01**

PERCOLATION TEST

Project: Geobase - Lake Forest
Staff: NB
Boring Dia. (in): 7.00

Hours Presaturated: 24.00

Project #: GOB-11-003
Drillers: JDK Drilling
Date Tested: May 6, 2011
Method Used to Prevent Sidewall Caving: Gravel Packed

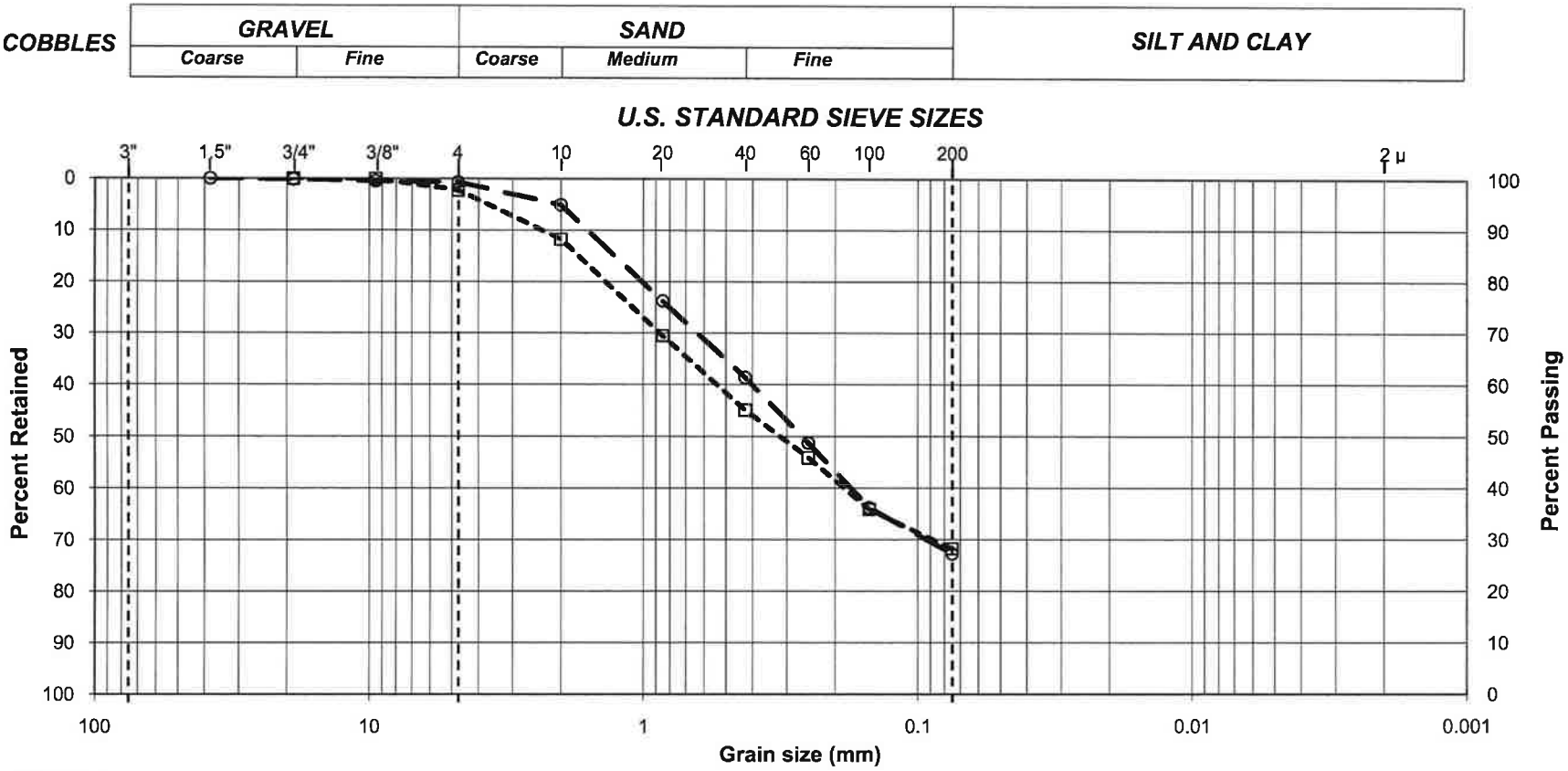
Boring ID	Initial Water Depth (ft)	Measured Water Depth (ft)	Start Time (hr:min:sec)	End Time (hr:min:sec)	T, Time Interval (hr)	F, Drop During Time Interval (ft)	L, Average Wetted Depth (ft)	D, Boring Diameter (ft)	Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (gal/sf/day)	Corrected Q, Percolation Rate (in/hr)
B-3	0.00	0.54	11:37:00 AM	12:07:00 PM	0.5000	0.54	6.73	0.58	0.8	0.8	**0.05**
Total Depth (ft):	0.00	0.31	12:08:00 PM	12:38:00 PM	0.5000	0.31	6.84	0.58	0.5	0.5	**0.03**
7	0.00	0.54	12:39:00 PM	1:09:00 PM	0.5000	0.54	6.73	0.58	0.8	0.8	**0.05**
	0.00	0.48	1:10:00 PM	1:40:00 PM	0.5000	0.48	6.76	0.58	0.7	0.7	**0.05**
	0.00	0.48	1:41:00 PM	2:11:00 PM	0.5000	0.48	6.76	0.58	0.7	0.7	**0.05**
	0.00	0.48	2:12:00 PM	2:42:00 PM	0.5000	0.48	6.76	0.58	0.7	0.7	**0.05**
	0.00	0.44	2:43:00 PM	3:13:00 PM	0.5000	0.44	6.78	0.58	0.7	0.6	**0.04**
	0.00	0.44	3:14:00 PM	3:44:00 PM	0.5000	0.44	6.78	0.58	0.7	0.6	**0.04**
	0.00	0.44	3:45:00 PM	4:15:00 PM	0.5000	0.44	6.78	0.58	0.7	0.6	**0.04**
	0.00	0.44	4:16:00 PM	4:46:00 PM	0.5000	0.44	6.78	0.58	0.7	0.6	**0.04**
	0.44	0.73	4:46:00 PM	5:16:00 PM	0.5000	0.29	6.42	0.58	0.5	0.5	**0.03**
	0.73	0.98	5:16:00 PM	5:46:00 PM	0.5000	0.25	6.15	0.58	0.4	0.4	**0.03**

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

PARTICLE-SIZE ANALYSIS OF SOILS
(ASTM D422)

Client: Geobase
Project Name: Lake Forest
Project No.: --

HAI Project No.: GOB-11-003
Tested by: KL/PM
Checked by: NB
Date: 5/10/2011



Boring No.	Sample No.	Depth (ft)	Symbol	USCS	% Gravel	% Sand	% Fines
B 1	Bulk	---	○	Gray, Clayey Sand (SC)	0.7	72.0	27.2
B 3		---	□	Gray, Clayey Sand (SC)	2.3	69.4	28.2

Manual on Estimating Soil Properties for Foundation Design

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Section 7

PERMEABILITY

The coefficient of permeability (k) of soil, also known as the hydraulic conductivity, describes the rate of water flow through soil. This soil property often is difficult to evaluate with certainty, because it varies over many orders of magnitude and in-situ soil conditions are highly variable. In addition to controlling the amount and rate of ground water inflow into foundation excavations, the coefficient of permeability also governs the rate of primary consolidation and equalization of pore water stresses.

TYPICAL VALUES

The value of the coefficient of permeability can vary over a wide range, as shown in Table 7-1. From this table, it is clear that k is highly dependent upon soil particle size. To obtain a first-order estimate of k in sands, Figure 7-1 suggests

Table 7-1

COEFFICIENT OF PERMEABILITY

Soil	Coefficient of Permeability, k (m/sec)	Relative Permeability
gravel	$> 10^{-3}$	high
sandy gravel, clean sand, fine sand	10^{-3} to 10^{-5}	medium
sand, dirty sand, silty sand	10^{-5} to 10^{-7}	low
silt, silty clay	10^{-7} to 10^{-9}	very low
clay	$< 10^{-9}$	practically impermeable

Source: Based on Terzaghi and Peck (1).

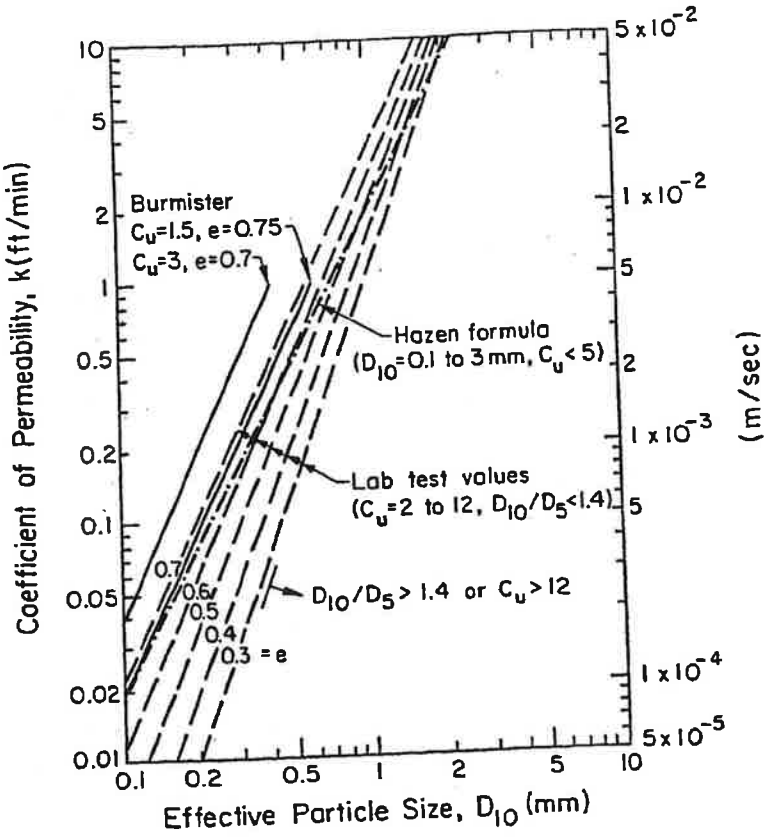

Figure 7-1. Coefficient of Permeability versus Particle Size

Source: NAVFAC (2), p. 7.1-139.

an approach in terms of void ratio (e) and effective particle size (expressed as D_{10}). The effect of particle size distribution and relative density on k is shown for several sands in Figure 7-2. The notation used is given in Table 2-7.

The in-situ vertical permeability (k_v) of clay may be estimated from the void ratio, plasticity index (PI), and clay fraction (CF), as shown in Figure 7-3. In geotechnical problems, drainage can occur horizontally as well as vertically. The ratio of horizontal to vertical permeability (k_h/k_v) generally is less than 1.5 for marine clays and other massive deposits. However, in varved clays and stratified fluvial deposits, k_h/k_v easily can exceed 10, as shown in Figure 7-4. Values of k_h/k_v over 100 are possible.

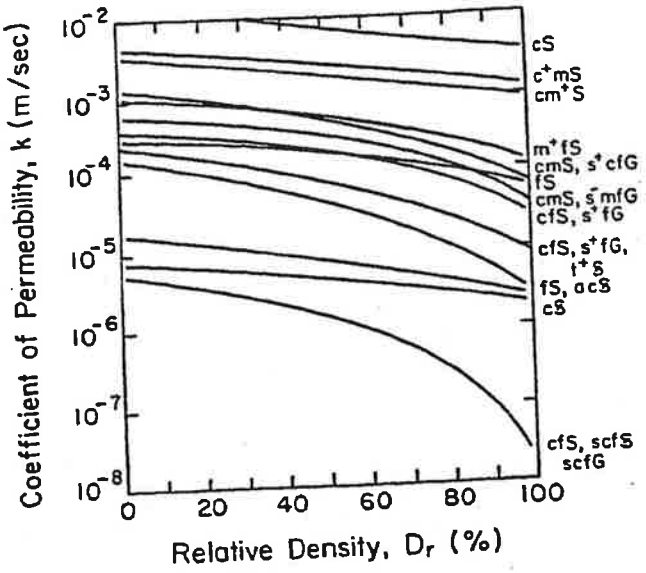

Figure 7-2. Coefficient of Permeability versus Particle Size and Relative Density

Source: Burmister (3), p. 78.

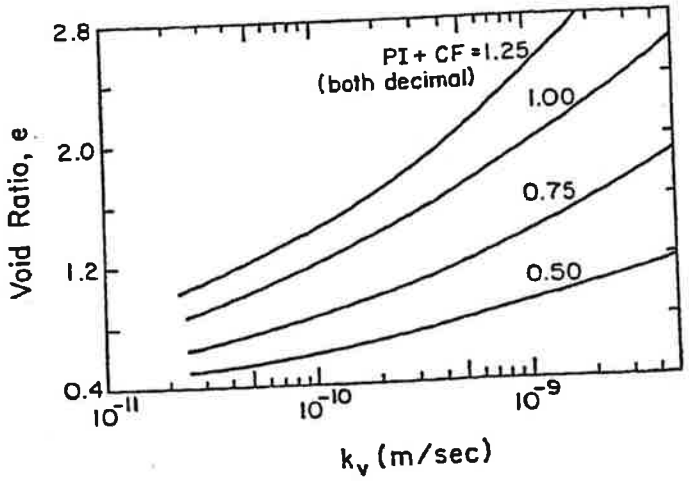

Figure 7-3. Vertical Coefficient of Permeability for Clay

Source: Tavenas, et al. (4), p. 658.